

HY-8 Quick Start Guide

This Quick Start guide is intended to provide essential information for installing and running the new Windows based version of the HY-8 culvert hydraulic analysis and design program.

What's in this Quick Start Document

This document includes information about downloading and installation of the program, some important differences between the older DOS version and this new Windows version, a simple tutorial problem to introduce you to the basic operation of HY-8, and ways to report bugs or other problems.

Technical Methods

HY-8 is a computerized implementation of FHWA culvert hydraulic approaches and protocols. The initial HY-8 program was first released in the early 1980's, however; FHWA has been producing computerized culvert hydraulic software since the early 1960's (with the HY-1 program).

The FHWA publication "Hydraulic Design Series 5: Hydraulic Design of Highway Culverts" (HDS-5) [publication FHWA-NHI-01-020, May 2005 revision] documents the technical methods applied in the HY-8 program and should be considered the primary technical reference for the software.

The HY-8 installation file includes the HDS-5 document as a portable document format (PDF) file. HDS-5 is also accessible from the HY-8 program Help menu. A hard copy of HDS-5 can be created by printing the PDF file.

For these reasons, FHWA certifies that this version of HY-8 continues to represent reviewed, tested, and accepted software for the purposes of performing FHWA culvert analyses regulated under 23 CFR 650 Subpart A and meeting 44 CFR 65.6(a)(6) in the FEMA NFIP regulations.

Downloading

The installation package (SETUP.ZIP) can be obtained by downloading from the FHWA Hydraulic website at: <http://www.fhwa.dot.gov/engineering/hydraulics/software/hy8>.

As stated in the FHWA Hydraulics website, by downloading the software, the user is agreeing that they accept responsibility for understanding the following conditions and limitations, and agrees to them:

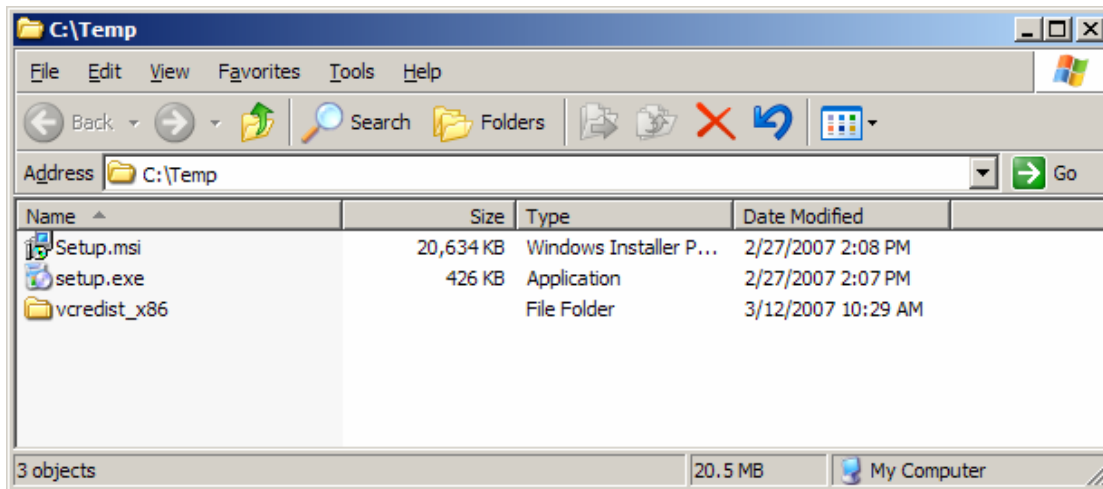
- FHWA does not provide user assistance or support for this software.
- The application of this software is the responsibility of the user. It is imperative that the responsible engineer understands the potential accuracy limitations of the program results, independently cross checks those results with other methods, and examines the reasonableness of the results with engineering knowledge and experience.
- There are no expressed or implied warranties.

Prior to Installation

Older versions of the HY-8 program should be removed from your system before trying to install an update. This is done by going to the Windows Control Panel and using the Add/Remove programs command. When doing so, project files you have created will not be deleted. After removing the older HY-8 version, you can install a new version.

Installation¹

Once downloaded to your computer, open the SETUP.ZIP file and extract three files (Setup.exe, Setup.msi, and vcredist_x86.exe) into a temporary or other folder. The last file – vcredist_x86.exe – MUST be placed in a sub-folder called “vcredist_x86” (as seen below).



Begin the installation of HY-8 by double-clicking (opening) the SETUP.EXE program.

You may get a screen such as:



¹ Depending on the operating system, HY8 installation may require access to Administrator rights. Should this be the case, contact your system or network administrator for assistance.

FHWA is the Publisher of HY-8. Select “Run” to continue installation.

Accepting Terms and Conditions

During the installation, the user is once again asked to review and accept the Terms and Conditions for using the HY-8 software.

Failure to accept these terms will result in non-installation of the program.

Default Program Location

The default location for program installation is folder: “C:\Program Files\FHWA\HY-8”.

However, a user can change the location to any directory without affecting the performance of the program. Use the *Browse* option to select an alternative (or new) folder.

Accessing the HY-8 program file

The Setup program will place a shortcut to the HY-8 program on the desktop. The Setup program will also automatically add a link to the HY8 program that can be accessed by clicking on *Start*, selecting *Programs*, and looking under the *HY-8* folder until encountering the *HY8* program icon.

Users with some experience with Windows may create additional shortcuts from here or by selecting the HY8.exe file found within the the C:\Program Files\FHWA\HY-8 folder.

After Installation, a user is ready to run the HY-8 program (there should be no need to Restart the computer).

Windows & DOS Versions: Changes and Additions

An important objective of the conversion of the HY-8 program to a Windows platform was maintaining the basic philosophy and simplicity of model input and operation. Additionally, a project development goal was to provide some backward compatibility in reading the existing input files (.INP).

While FHWA and the development team feels these goals and objectives have been largely achieved, there were obviously some things that FHWA wanted to change and add in order to take advantage of the more modern Windows operating system. This section outlines these changes and new features and will serve as a road map to users who have long used the DOS version of HY-8.

The Project File Approach

The new version of HY-8 differs from earlier DOS based version in adopting a *Project File* approach. These project files are implemented into the *Project Explorer* – allowing quick selection and application of a specific culvert system². As described below, the addition of this approach adds utility in (1) organizing and applying culvert systems within multiple drainage crossings and (2) during analyses of different design configurations and materials.

Multiple Drainage Crossings

The DOS version of HY-8 only allowed analysis or design of a single drainage crossing. While the user could define multiple culverts and barrels (systems) at this crossing, if an overall roadway project included many such crossing sites, each would need to be separated into a different input file.

This led to the proliferation of many separate culvert input files associated with a single roadway project. Some practitioners described their confusion in distinguishing which culvert file was associated with which drainage crossing within a project.

In the new version of HY-8, any number of crossings can be defined within the *project file*. Users now have the option of performing an analysis on several crossings and grouping them together. A new mapping feature (described below) helps the user to create a map identifying each crossing that can be included in their report.

Of course, the Windows version retains older version's ability to consider only a single drainage crossing. This single crossing can also still consist of multiple culvert systems (e.g., three circular barrels at one invert [system 1] and a box culvert at another invert [system 2] at the same roadway crossing).

² As in prior versions of HY-8, a *culvert system* is considered as a collection of culverts, having the same type, material, inlet, dimension, and layout (invert elevations, length) characteristics. So a single barrel corrugated metal pipe or a box culvert with cell barrels (cells) would be considered a system, whereas, if a crossing had both a circular HDPE AND a pipe arch, these would be considered two systems. A potential reason for multiple culvert systems at a crossing would be to allow "critter crossings" in one system and normal discharge through the other system.

Design Alternatives

The new version of HY-8 also provides an improved means to consider separate design alternatives of the same crossing within the same project file. In the DOS version of HY-8, a user would either have to load them as separate files, or make the incremental changes and reevaluate a single file.

The new version of HY-8 provides the user the option of “copying” a culvert and associated crossing information. With this “duplicate crossing” the user can make any change(s) they wish to evaluate. The project explorer then makes it easy to toggle back and forth between the alternative crossing designs.

File Conventions

The Windows version of HY-8 saves these Project Files using a “.HY8” extension. Unlike the DOS version of HY-8, the new version allows any file name format and length allowed by Windows. While HY-8 can read in older version .INP files, to protect this new utility and format, files can only be saved using this new format (and using the new “.HY8” files extension).

Order of Input

The DOS version of HY-8 presented the input as a series of linear, sequential input screens. The order always began with the discharge, followed by the culvert information, followed by the tailwater data, and ended with the roadway information.

In the Windows version of HY-8, a single input screen presents all of the input necessary to analyze a single crossing.

However, there are some important subtleties - the grouping of the information has been organized into “crossing” information and the “culvert” information. The discharge, tailwater, and roadway data are unique to the crossing while the culvert shape, inlet conditions, and site data define a culvert within the crossing.

This grouping, and therefore subsequent tabbing through the main input screen, does not follow the same linear progression of input as the DOS versions of HY-8.

Execution of *SINGLE* and *BALANCE*

The DOS version of HY-8 contained separate analysis functions for computing a culvert performance rating curve (*SINGLE* module), and a roadway overtopping analysis (*BALANCE* module) that included the effects of all culvert systems within a crossing.

When running this *SINGLE* module, DOS versions of HY-8 assumed that overtopping was not possible even though roadway data had been defined. Additionally, in the case where there were multiple culvert systems at the same crossing (e.g., a circular culvert and box culvert relatively side-by-side), the old *SINGLE* approach provided the performance curve of one of the systems (i.e., circular) assuming that the other system (i.e., box) was not present. One result was users potentially incorrectly applying *SINGLE* derived performance curve results.

The Windows version of HY-8 performs all culvert analysis considering hydraulic effects of all culvert systems in the crossing as well as roadway overtopping. This means that when you view the performance table (or plot) for a given culvert within the crossing you are seeing the

performance within the context of any other culverts and overtopping of the roadway for the crossing and not just as an isolated culvert.

If there is only a single culvert system and the roadway is high enough that overtopping does not occur, the performance curve of the old and new versions match.

Front View

The Windows version of HY-8 contains an option for displaying the front (upstream) view (elevations) of the culvert and roadway at the crossing. From a culvert hydraulics and numerical modeling perspective, computations do not need to consider the lateral placement of culverts within a crossing. Only the elevation relationships between the channel, roadway and other culverts are important.

The information requested in the DOS version HY-8 input screens and input files (.INP) reflected this simpler approach. This led to challenges in viewing and plotting these features within the front view area of the updated program.

Roadway Lateral Stationing

To view the (scaled) relationship between the roadway and culvert system in the front view, HY-8 will prompt the user to enter the lateral stationing of the culvert(s) vis-à-vis the roadway.

One reason for requesting this additional value is while irregular shaped roadway sections in HY-8 have always prompted for lateral stations and elevations, the constant elevation option only prompted for a roadway length. This lack of stationing made visual presentation of the culvert location vis-à-vis the roadway problematic³.

In order to allow for the possibility of defining actual stationing along a roadway, the Windows version of HY-8 includes a beginning station as well as the length for constant roadway profiles. The default beginning roadway station ordinate is zero and can be left as zero if actual stationing is not known (or not important).

Lateral stations are defined from the beginning (left, facing downstream) side of the roadway and elevations taken from the upstream invert elevation parameter.

Note on Culvert Barrel plots

To allow backward compatibility with DOS version input files, the new version does not currently plot more than one barrel of a particular system. So while the program plots multiple systems at a crossing, the number of barrels within each system is not plotted. This multi-barrel plotting capability will be added in a subsequent upgrade.

Note on Channel Cross Section plots

As the front view represents the upstream view and because there is no cross section defined for the upstream end of the culvert, no channel cross section is plotted for the front view (the new version of the HY-8 program does plot the downstream channel cross section in a different portion of the program).

³ Conceivably, the old DOS version of HY-8 could have used differing stationing values between culvert centerline, channel station, and roadway values without any loss of hydraulic accuracy. This confused some practitioners.

The reason for this approach is that in culvert hydraulic practice assumes steady flow, associated with some design frequency. An upstream channel cross section is only needed when considering storage for inflow hydrograph routing. Requiring a user to add these upstream coordinates for a simple culvert layout and this steady flow assumption overly complicates the data requirements and the input process.

Even approaches as simple as projecting the downstream channel along the culvert barrel to the upstream invert were rejected as this assumed a certain positioning of the channel and culvert barrel, as well as assumptions of roadway, barrel, and channel skew.

Background Map

Because multiple crossings can be defined within a single HY-8 project there is an option to create a background map. This map is only a picture and can be defined from any bitmap (.bmp) file. If you are connected to the internet you may search for a roadway or aerial view map online and save the result as your background map. You may also screen capture any image (i.e. a CAD drawing) and save that image as a bitmap (.bmp) file to import and use for your map as well. The map is only used for reference purposes and it or locations defined for culverts have no bearing on any calculations. Currently the map is sent to the report document, but you can cut and paste it into the file by capturing it from the screen.

Report Generation

The DOS version of HY-8 generated a comprehensive table that could be sent to a text file. However the old version lacked the ability to include graphs and take advantage of formatting in modern word processing programs

The Windows version of HY-8 includes Report Generation tools that are customizable, allow many options for plots, and are saved in rich text format (RTF) or portable document format (PDF). The primary target for the report is an MS-Word document; however, an rtf format is readable by most Windows-based word processing programs.

Known Issues

A few issues related to Report Generation exist with this initial version. These will be corrected in future releases. These issues stem from a problem of placing tables and graphs within document text. In this initial version, each time a table or graph is written to the report, the report starts a new page. This can make reports longer (wasting paper).

This is because of a limitation in the report generation library routines that do not allow tables and graphs to be “docked” in line with text. When trying to condense a report, these tables and plots may cover the text.

Workaround

After exporting a report you can manually dock tables in MS Word by selecting the table frame and then right-clicking on the upper left frame border and choosing the *Format Frame* option. In this screen select the “Remove Frame” button.

For graphs you will select the graphic and right-click inside choosing the *Format Picture* option. In this screen choose the *Layout* tab and then the “In Line with Text” option.

Once these options are set for tables and graphs new page/sections can be deleted and the tables and graphs placed continuously. It is FHWA's intention to correct this limitation within the library functions used for report generation soon.

Known HY-8 Issues

A few issues continue to exist in HY-8, most of which are carried over as limitations from the DOS version. The following is a list of these issues:

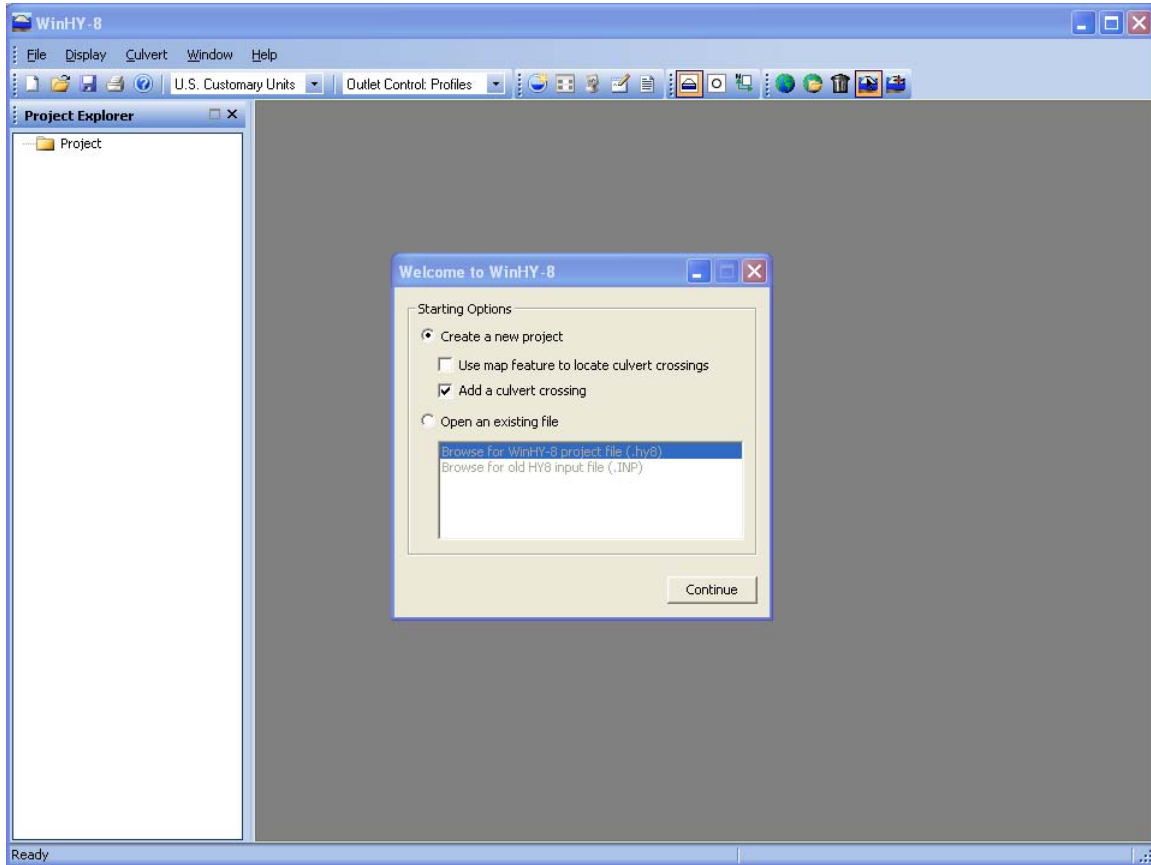
1. HY-8 does not attempt to show the location of a hydraulic jump in the culvert profile.
2. If more than one flow type exists for the culvert profile, HY-8 does not attempt to show multiple profiles, but only that of the design discharge.
3. **NOTE:** The user should be aware that when the tailwater elevation exceeds the elevation of the top of the culvert outlet, HY-8 assumes that the barrel flows full at the outlet and reports an outlet velocity corresponding to full flow. A more detailed description of this limitation is given in the Help document under the limitations topic.
4. At this time, the new version of HY-8 does not support several culvert types, such as CONSPAN or HDPE plastic. FHWA intends to add these culvert types in the next upgrade.
5. The new version of HY-8 does not support partially buried culverts or culverts with natural stream bottoms. However, as with the old version, the user may define a user supplied shape that includes different roughness for the sides/top and bottom.
6. The new version of HY-8 does not support culverts with multiple slopes (broken back) and adverse slopes. These are being added in the next phase of this effort.
7. The report functionality in HY-8 will be improved to support additional file formats and additional options.

HY-8 Quick Start Tutorial

This tutorial shows how to setup a single culvert in HY-8. The tutorial also shows how to view all the results of the culvert analysis. It is meant to be an introduction to using HY-8 for culvert analysis and is by no means a comprehensive reference to all the capabilities of HY-8. A more complete list of HY-8's capabilities is contained in the HY-8 help file.

Starting a Project

1. Startup HY-8. The following window will appear:



2. Select *Continue* to add a new culvert crossing.

Entering Project Data

3. Enter the following into the “Discharge Data” section of the *Crossing Data* window:

Minimum Flow	0.0 cfs
Design Flow	400.0 cfs
Maximum Flow	500.0 cfs

4. Enter the following into the “Tailwater Data” section of the *Crossing Data* window:

Channel Type	Trapezoidal Channel
Bottom Width	8.0 ft
Side Slope (H:V)	2.0 (_:1)
Channel Slope	0.04 ft/ft
Manning's n (channel)	0.032
Channel Invert Elevation	89.2 ft

5. Select the “View” button to view the rating curve:

Crossing Data - Crossing 2

Crossing Properties
Name: Crossing 1

Parameter	Value	Units
DISCHARGE DATA		
Minimum Flow	0.00	cfs
Design Flow	400.00	cfs
Maximum Flow	500.00	cfs
TAILWATER DATA		
Channel Type	Trapezoidal Channel	
Bottom Width	8.00	ft
Side Slope (H:V)	2.00	:1
Channel Slope	0.0400	ft/ft
Manning's n (channel)	0.0320	
Channel Invert Elevation	89.20	ft
Rating Curve	View...	
ROADWAY DATA		
Roadway Profile Shape	Constant Roadway Elevation	
First Roadway Station	0.00	ft
Crest Length	0.00	ft
Crest Elevation	0.00	ft
Roadway Surface	Paved	
Top Width	0.00	ft

Help Click on any icon for help on a specific topic

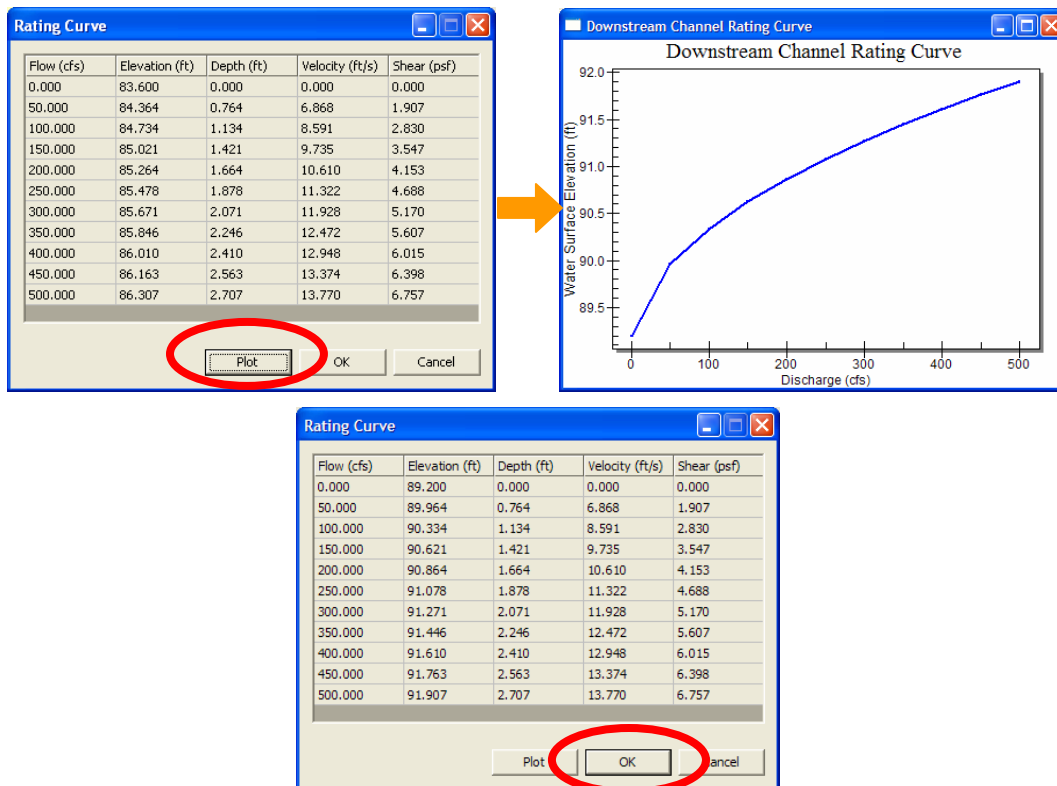
Analyze Crossing OK Cancel

Culvert Properties

Culvert 1 Add Culvert Duplicate Culvert Delete Culvert

Parameter	Value	Units
CULVERT DATA		
Name	Culvert 1	
Shape	Circular	
Material	Concrete	
Diameter	0.00	ft
Manning's n	0.0120	
Inlet Type	Conventional	
Inlet Edge Condition	Square Edge with Headwall	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	0.00	ft
Inlet Elevation	0.00	ft
Outlet Station	0.00	ft
Outlet Elevation	0.00	ft
Number of Barrels	1	

6. Plot the Rating Curve if you wish, but when you are finished, close the plot window and choose “OK” in the Rating Curve window.



7. Enter the following into the “Roadway Data” section of the *Crossing Data* window:

Roadway Profile Shape	Constant Roadway Elevation
First Roadway Station	0.0 ft
Crest Length	100.0 ft
Crest Elevation	110.0 ft
Roadway Surface	Paved
Top Width	150.0 ft

8. Enter the following into the “Culvert Data” section of the *Crossing Data* window:

Name	Example 6
Shape	Concrete Box
Material	Concrete
Span	6.0 ft
Rise	5.0 ft
Manning's n	0.012
Inlet Type	Conventional
Inlet Edge Condition	1:1 Bevel Headwall
Inlet Depression?	No

9. Enter the following into the “Site Data” section of the *Crossing Data* window:

Site Data Input Option	Culvert Invert Data
Inlet Station	0.0 ft
Inlet Elevation	90.0 ft
Outlet Station	160.0 ft
Outlet Elevation	89.2 ft
Number of Barrels	1

Running an Analysis

10. Select the *Analyze Crossing* button at the bottom of the *Crossing Data* window. (This runs the analysis, but does not save the information).

Crossing Data - Crossing 1

Crossing Properties

Name: Crossing 1

Parameter	Value	Units
DISCHARGE DATA		
Minimum Flow	0.00	cfs
Design Flow	400.00	cfs
Maximum Flow	500.00	cfs
TAILWATER DATA		
Channel Type	Trapezoidal Channel	
Bottom Width	8.00	ft
Side Slope (H:V)	2.00	:1
Channel Slope	0.0400	ft/ft
Manning's n (channel)	0.0320	
Channel Invert Elevation	89.20	ft
Rating Curve	View...	
ROADWAY DATA		
Roadway Profile Shape	Constant Roadway Elevation	
First Roadway Station	0.00	ft
Crest Length	100.00	ft
Crest Elevation	110.00	ft
Roadway Surface	Paved	
Top Width	150.00	ft

Culvert Properties

Example 6

Add Culvert
Duplicate Culvert
Delete Culvert

Parameter	Value	Units
CULVERT DATA		
Name	Example 6	
Shape	Concrete Box	
Material	Concrete	
Span	6.00	ft
Rise	5.00	ft
Manning's n	0.0120	
Inlet Type	Conventional	
Inlet Edge Condition	1:1 Bevel Headwall	
Inlet Depression?	No	
SITE DATA		
Site Data Input Option	Culvert Invert Data	
Inlet Station	0.00	ft
Inlet Elevation	90.00	ft
Outlet Station	160.00	ft
Outlet Elevation	89.20	ft
Number of Barrels	1	

Help Click on any icon for help on a specific topic

Analyze Crossing OK Cancel

11. Select the *Crossing Rating Curve* button.

Summary of Flows at Crossing - Crossing 1

Headwater Elevation (ft)	Total Discharge (cfs)	Example 6 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
90.00	0.00	0.00	0.00	1
92.06	50.00	50.00	0.00	1
93.20	100.00	100.00	0.00	1
94.18	150.00	150.00	0.00	1
95.12	200.00	200.00	0.00	1
96.09	250.00	250.00	0.00	1
97.14	300.00	300.00	0.00	1
98.31	350.00	350.00	0.00	1
99.63	400.00	400.00	0.00	1
101.11	450.00	450.00	0.00	1
102.76	500.00	500.00	0.00	1

Display

☒ Crossing Summary Table

☐ Culvert Summary Table Example 6

☐ Water Surface Profiles

☐ Improved Inlet Table

☐ Customized Table Options...

Geometry

Inlet Elevation: 90.00 ft
Outlet Elevation: 89.20 ft
Culvert Length: 160.00 ft
Culvert Slope: 0.0050
Inlet Crest: 0.00 ft
Inlet Throat: 0.00 ft

Plot

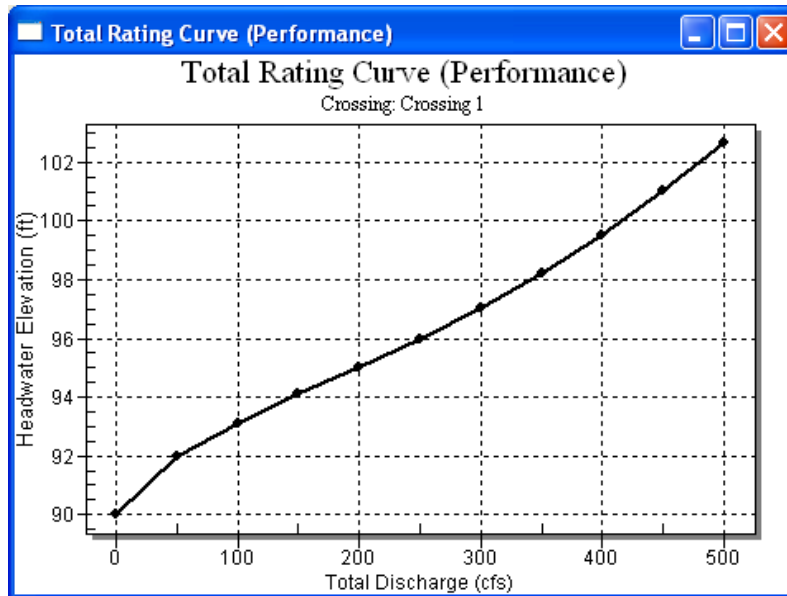
Crossing Rating Curve

Culvert Performance Curve

Selected Water Profile

Help Flow Types... Edit Input Data... Outlet Control: Profiles Close

12. A plot of the rating curve (Headwater Elevation vs. Discharge) will appear. After viewing this curve, close the plot window.



13. Select the *Culvert Summary Table* option in the *Display* box. Any of the data displayed in any of the spreadsheets in this window can be selected, copied (using *Ctrl+C*), and pasted into any spreadsheet program.

Culvert Summary Table - Example 6

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	90.00	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
50.00	50.00	92.06	2.06	0.00	1-S2n	1.09	1.29	1.09	0.76	7.63	6.87
100.00	100.00	93.20	3.20	0.33	1-S2n	1.76	2.06	1.76	1.13	9.45	8.59
150.00	150.00	94.18	4.18	0.62	1-S2n	2.36	2.69	2.36	1.42	10.58	9.73
200.00	200.00	95.12	5.12	0.86	5-S2n	2.92	3.26	2.92	1.66	11.40	10.61
250.00	250.00	96.09	6.09	1.08	5-S2n	3.46	3.79	3.46	1.88	12.04	11.32
300.00	300.00	97.14	7.14	1.27	5-S2n	3.98	4.28	3.98	2.07	12.55	11.93
350.00	350.00	98.31	8.31	1.45	5-S2n	4.49	4.74	4.49	2.25	12.98	12.47
400.00	400.00	99.63	9.63	8.73	5-S2n	5.00	5.00	5.00	2.41	13.33	12.95
450.00	450.00	101.11	11.11	9.94	5-S2n	5.00	5.00	5.00	2.56	15.00	13.37
500.00	500.00	102.76	12.76	11.28	5-S2n	5.00	5.00	5.00	2.71	16.67	13.77

Display

- ☐ Crossing Summary Table
- ☒ Culvert Summary Table Examp. 6
- ☐ Water Surface Profiles
- ☐ Improved Inlet Table
- ☐ Customized Table Options...

Geometry

Inlet Elevation: 90.00 ft
 Outlet Elevation: 89.20 ft
 Culvert Length: 160.00 ft
 Culvert Slope: 0.0050
 Inlet Crest: 0.00 ft
 Inlet Throat: 0.00 ft

Plot

Crossing Rating Curve
Culvert Performance Curve
Selected Water Profile

Help Flow Types... Edit Input Data... Outlet Control: Profiles Close

14. Select the *Culvert Performance Curve* button.

Culvert Summary Table - Example 6

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	90.00	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
50.00	50.00	92.06	2.06	0.00	1-S2n	1.09	1.29	1.09	0.76	7.63	6.87
100.00	100.00	93.20	3.20	0.33	1-S2n	1.76	2.06	1.76	1.13	9.45	8.59
150.00	150.00	94.18	4.18	0.62	1-S2n	2.36	2.69	2.36	1.42	10.58	9.73
200.00	200.00	95.12	5.12	0.86	5-S2n	2.92	3.26	2.92	1.66	11.40	10.61
250.00	250.00	96.09	6.09	1.08	5-S2n	3.46	3.79	3.46	1.88	12.04	11.32
300.00	300.00	97.14	7.14	1.27	5-S2n	3.98	4.28	3.98	2.07	12.55	11.93
350.00	350.00	98.31	8.31	1.45	5-S2n	4.49	4.74	4.49	2.25	12.98	12.47
400.00	400.00	99.63	9.63	1.63	5-S2n	5.00	5.00	5.00	2.41	13.33	12.95
450.00	450.00	101.11	11.11	1.84	5-S2n	5.00	5.00	5.00	2.56	15.00	13.37
500.00	500.00	102.76	12.76	2.08	5-S2n	5.00	5.00	5.00	2.71	16.67	13.77

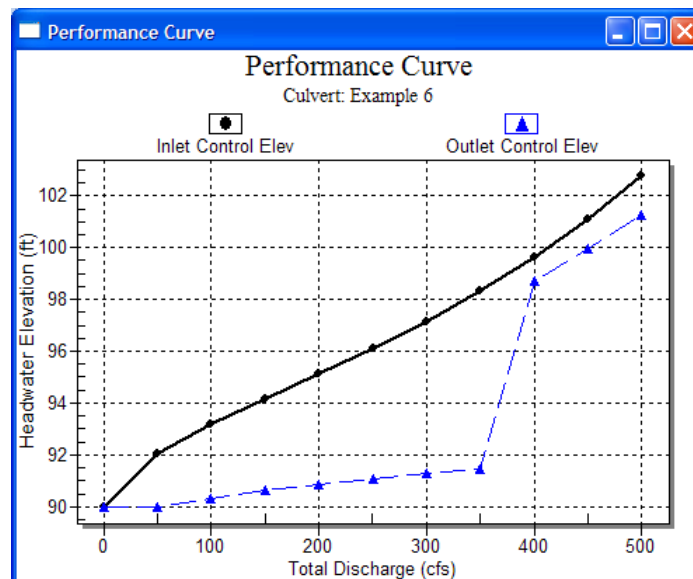
Display: ☐ Crossing Summary Table ☒ Culvert Summary Table ☐ Water Surface Profiles ☐ Improved Inlet Table ☐ Customized Table

Geometry: Inlet Elevation: 90.00 ft, Outlet Elevation: 89.20 ft, Culvert Length: 160.00 ft, Culvert Slope: 0.0050, Inlet Crest: 0.00 ft, Inlet Throat: 0.00 ft

Plot:

Help Flow Types... Edit Input Data... Outlet Control: Profiles

15. A plot of the performance curve (Inlet/Outlet control Headwater Elevation vs. Discharge) will appear. After viewing this curve, close the plot window.



16. Select the *Water Surface Profiles* option in the *Display* box.

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Length Full (ft)	Length Free (ft)	Last Step (ft)	Mean Slope (%)	First Depth (ft)	Last Depth (ft)
0.00	0.00	90.00	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
50.00	50.00	92.06	2.06	0.00	1-S2n	0.00	160.00	76.62	0.51	1.29	0.99
100.00	100.00	93.20	3.20	0.33	1-S2n	0.00	160.00	128.74	0.47	2.06	1.76
150.00	150.00	94.18	4.18	0.62	1-S2n	0.00	160.00	55.94	0.49	2.69	2.29
200.00	200.00	95.12	5.12	0.86	5-S2n	0.00	160.00	65.98	0.49	3.26	2.86
250.00	250.00	96.09	6.09	1.08	5-S2n	0.00	160.00	50.14	0.50	3.79	3.39
300.00	300.00	97.14	7.14	1.27	5-S2n	0.00	160.00	130.17	0.49	4.28	3.98
350.00	350.00	98.31	8.31	1.45	5-S2n	0.00	160.00	115.22	0.50	4.74	4.44
400.00	400.00	99.63	9.63	8.73	5-S2n	0.00	160.00	160.00	0.60	5.00	4.90
450.00	450.00	101.11	11.11	9.94	5-S2n	0.00	160.00	160.00	0.65	5.00	4.90
500.00	500.00	102.76	12.76	11.28	5-S2n	0.00	160.00	160.00	0.69	5.00	4.90

Display:

- ☐ Crossing Summary Table
- ☐ Culvert Summary Table Example 6
- ☒ Water Surface Profiles
- ☐ Improved Inlet Table
- ☐ Customized Table Options...

Geometry:

Inlet Elevation: 90.00 ft
 Outlet Elevation: 89.20 ft
 Culvert Length: 160.00 ft
 Culvert Slope: 0.0050
 Inlet Crest: 0.00 ft
 Inlet Throat: 0.00 ft

Plot:

Crossing Rating Curve
 Culvert Performance Curve
 Selected Water Profile

Help Flow Types... Edit Input Data... Outlet Control: Profiles Close

17. Select the 400 cfs profile (third from the bottom) and select the *Selected Water Profile* button.

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Length Full (ft)	Length Free (ft)	Last Step (ft)	Mean Slope (%)	First Depth (ft)	Last Depth (ft)
0.00	0.00	90.00	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
50.00	50.00	92.06	2.06	0.00	1-S2n	0.00	160.00	152.15	0.51	1.29	1.09
100.00	100.00	93.20	3.20	0.33	1-S2n	0.00	160.00	132.80	0.50	2.06	1.77
150.00	150.00	94.18	4.18	0.62	1-S2n	0.00	160.00	211.08	0.50	2.69	2.37
200.00	200.00	95.12	5.12	0.86	5-S2n	0.00	160.00	332.39	0.50	3.26	2.93
250.00	250.00	96.09	6.09	1.08	5-S2n	0.00	160.00	554.37	0.50	3.79	3.46
300.00	300.00	97.14	7.14	1.27	5-S2n	0.00	160.00	8.68	0.50	4.28	3.99
350.00	350.00	98.31	8.31	1.45	5-S2n	0.00	160.00	254.51	0.50	4.74	4.50
400.00	400.00	99.63	9.63	8.73	5-S2n	0.00	160.00	0.00	0.77	5.00	5.00
450.00	450.00	101.11	11.11	9.94	5-S2n	0.00	160.00	0.00	0.97	5.00	5.00
500.00	500.00	102.76	12.76	11.28	5-S2n	0.00	160.00	0.00	1.20	5.00	5.00

Display:

- ☐ Crossing Summary Table
- ☐ Culvert Summary Table Example 6
- ☒ Water Surface Profiles
- ☐ Improved Inlet Table
- ☐ Customized Table Options...

Geometry:

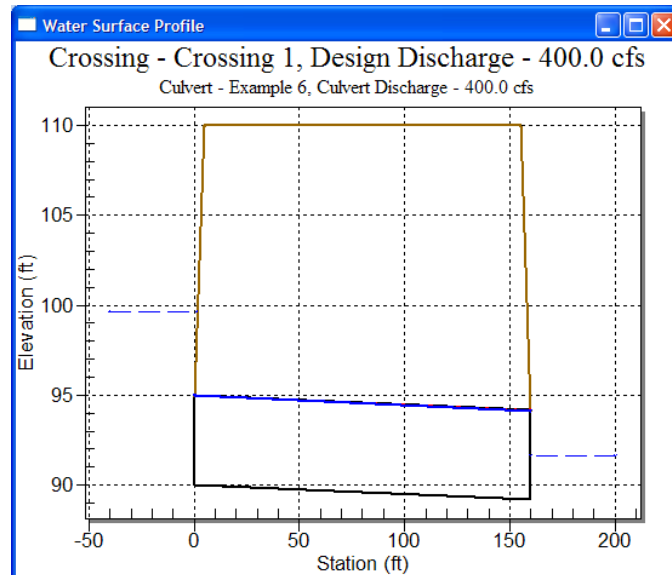
Inlet Elevation: 90.00 ft
 Outlet Elevation: 89.20 ft
 Culvert Length: 160.00 ft
 Culvert Slope: 0.0050
 Inlet Crest: 0.00 ft
 Inlet Throat: 0.00 ft

Plot:

Crossing Rating Curve
 Culvert Performance Curve
 Selected Water Profile

Help Flow Types... Edit Input Data... Outlet Control: Profiles Close

18. A plot of the culvert profile (for the selected discharge of 400 cfs) will appear. After viewing this curve, close the plot window.



19. Select the *Close* button on the Analysis window.

Water Surface Profile Table - Example 6

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Length Full (ft)	Length Free (ft)	Last Step (ft)	Mean Slope (%)	First Depth (ft)	Last Depth (ft)
0.00	0.00	90.00	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
50.00	50.00	92.06	2.06	0.00	1-S2n	0.00	160.00	152.15	0.51	1.29	1.09
100.00	100.00	93.20	3.20	0.33	1-S2n	0.00	160.00	132.80	0.50	2.06	1.77
150.00	150.00	94.18	4.18	0.62	1-S2n	0.00	160.00	211.08	0.50	2.69	2.37
200.00	200.00	95.12	5.12	0.86	5-S2n	0.00	160.00	332.39	0.50	3.26	2.93
250.00	250.00	96.09	6.09	1.08	5-S2n	0.00	160.00	554.37	0.50	3.79	3.46
300.00	300.00	97.14	7.14	1.27	5-S2n	0.00	160.00	8.68	0.50	4.28	3.99
350.00	350.00	98.31	8.31	1.45	5-S2n	0.00	160.00	254.51	0.50	4.74	4.50
400.00	400.00	99.63	9.63	8.73	5-S2n	0.00	160.00	0.00	0.77	5.00	5.00
450.00	450.00	101.11	11.11	9.94	5-S2n	0.00	160.00	0.00	0.97	5.00	5.00
500.00	500.00	102.76	12.76	11.28	5-S2n	0.00	160.00	0.00	1.20	5.00	5.00

Display:

- ☐ Crossing Summary Table
- ☐ Culvert Summary Table Example 6
- ☒ Water Surface Profiles
- ☐ Improved Inlet Table
- ☐ Customized Table Options...

Geometry:

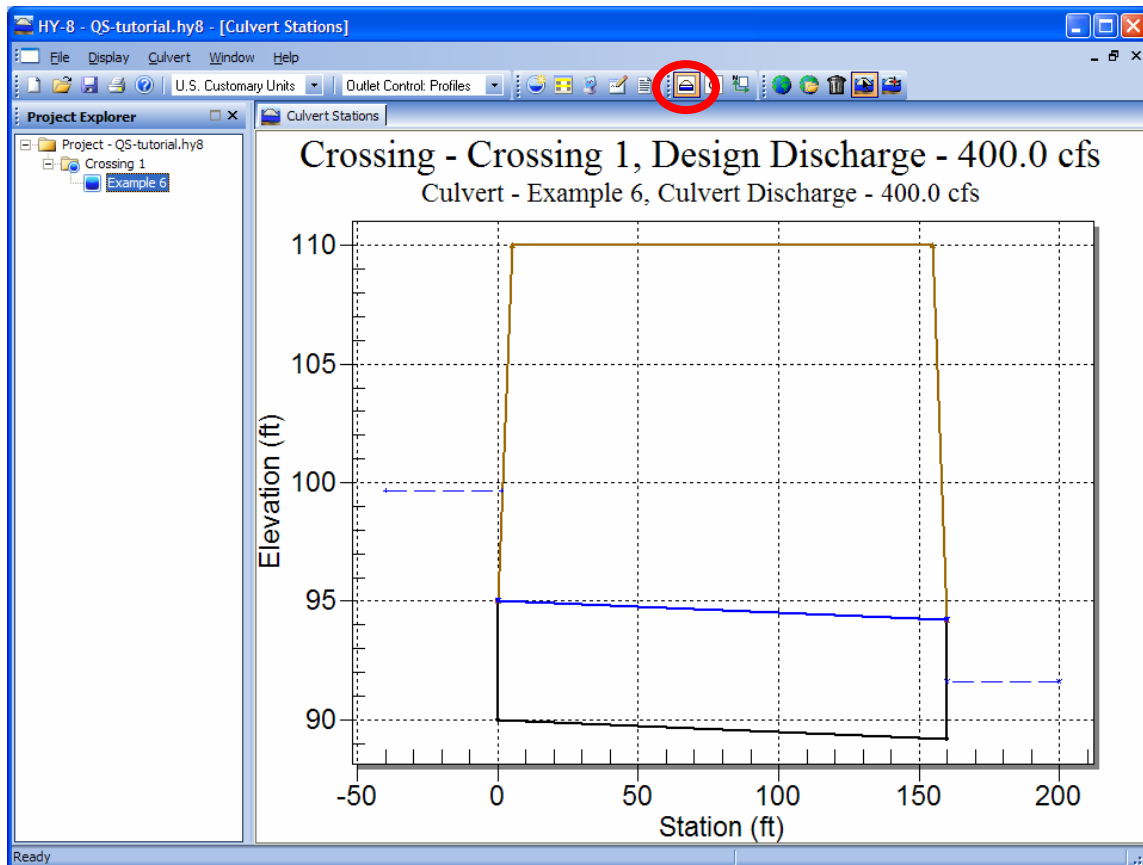
- Inlet Elevation: 90.00 ft
- Outlet Elevation: 89.20 ft
- Culvert Length: 160.00 ft
- Culvert Slope: 0.0050
- Inlet Crest: 0.00 ft
- Inlet Throat: 0.00 ft

Plot:

-
-
-
-

Help Flow Types... Edit Input Data... Outlet Control: Profiles

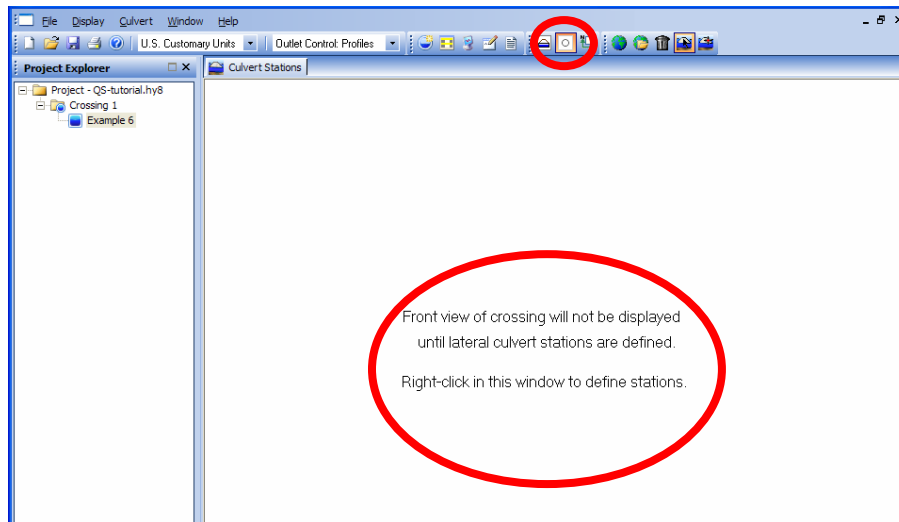
20. Select the “Example 6” culvert in the project explorer to show the culvert profile for the design discharge in the main window. Notice that the Culvert Profile icon is active.



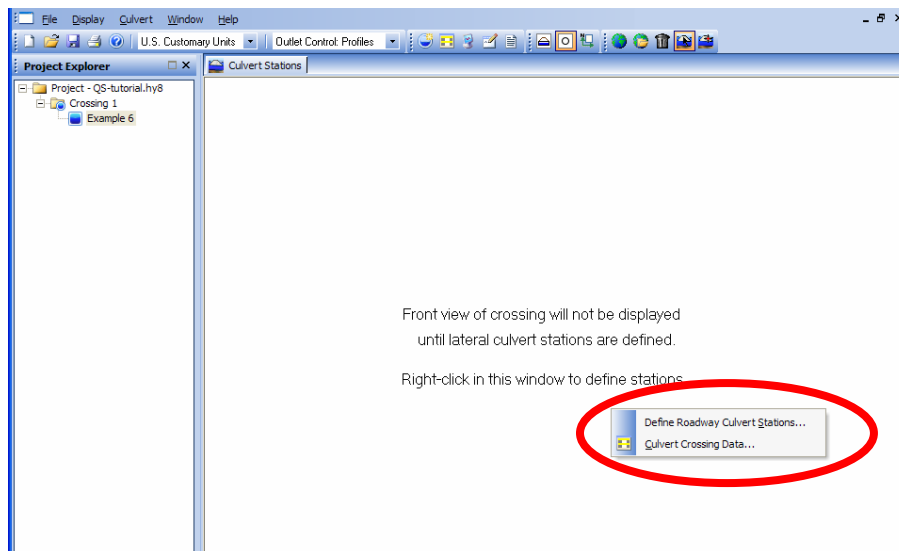
Optional: Defining Front View

Should the user wish to define the front view, they can do so at this (or any other time after entering crossing and culvert information). Recall that details regarding this option were discussed earlier in this document.

- FV-1 Select the Front View icon. A message will appear in the Main Window describing the requirement to define lateral culvert stations. Right click to do so.



- FV-2 A message will appear. Select “Define Roadway Culvert Stations”



- FV-3 The Roadway Profile window appears. Notice that the roadway station data (0.00 ft and 100.00 ft) entered back in Step 7 is in the Window. Click on the Example 6 Station field (currently the default of zero).

Roadway Profile Culvert Sta...

Roadway Data

First Roadway Station: 0.00 ft

Roadway Crest Length: 100.00 ft

Culvert Stations

Culvert Name	Station (ft)
Example 6	0.00

OK Cancel

- FV-4 Enter the station of the centerline of the culvert system. For this example, let's assume that this is at roadway station 50.0 feet (or halfway between the roadway section acting as a weir).

Roadway Profile Culvert Sta...

Roadway Data

First Roadway Station: 0.00 ft

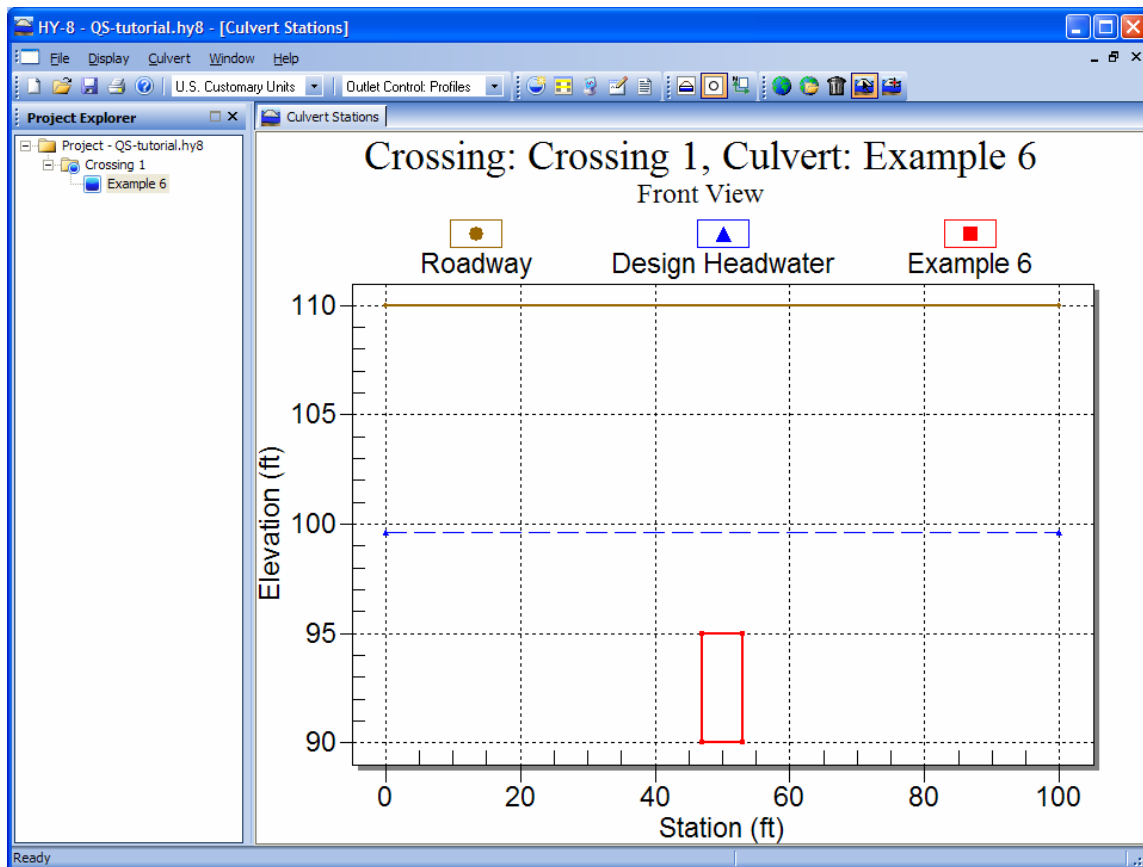
Roadway Crest Length: 100.00 ft

Culvert Stations

Culvert Name	Station (ft)
Example 6	50.00

OK Cancel

FV-5 Choose “OK” and the Main Window presents the Front View of the crossing.



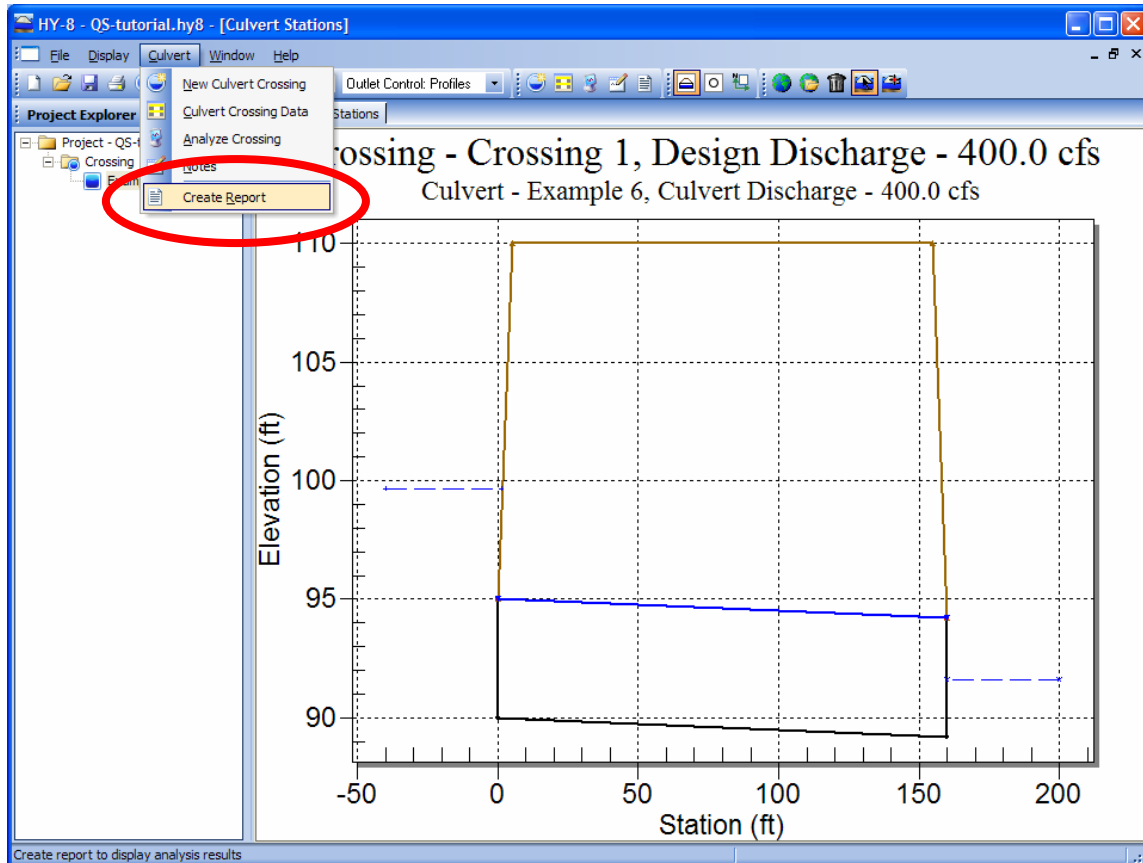
The user can “switch” between the Front View and Side View by selecting the appropriate icon. Notice that when the cursor is over a toolbar icon, a short help message in the lower left of the program window appears.

Saving the Project File

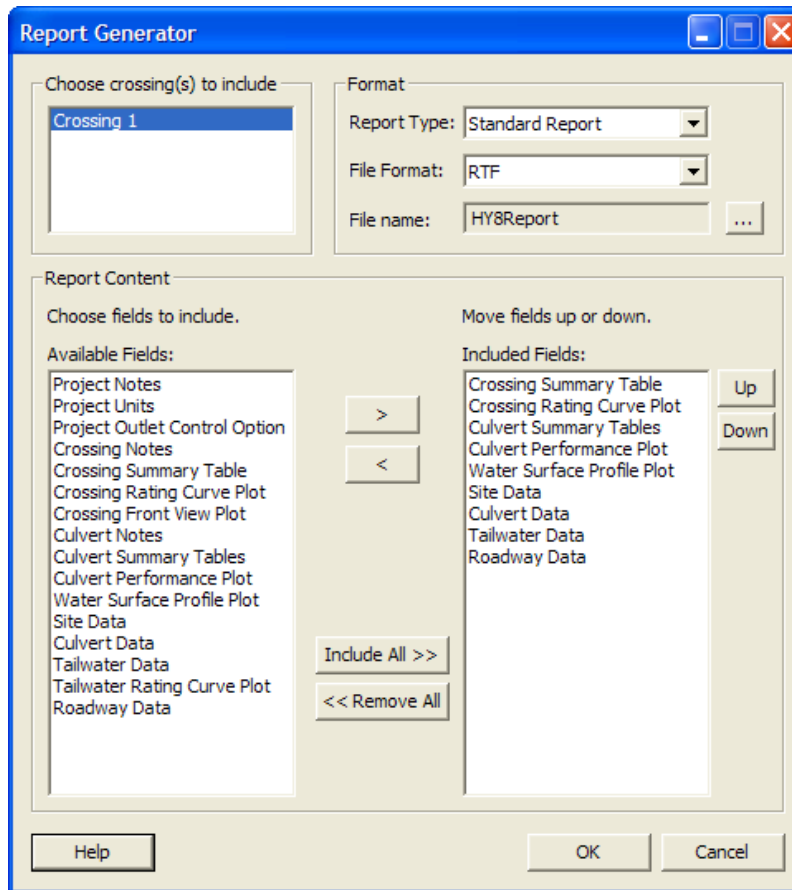
21. This may be a good time to Save the Project File. Select the *Save As* option from the *File* menu. When prompted, call the project file *QS-Tutorial* . The program will automatically add the .HY8 extension to this file.

Viewing Report

22. Select the *Create Report* option from the *Culvert* menu.



23. The *Report Generator* window will appear:

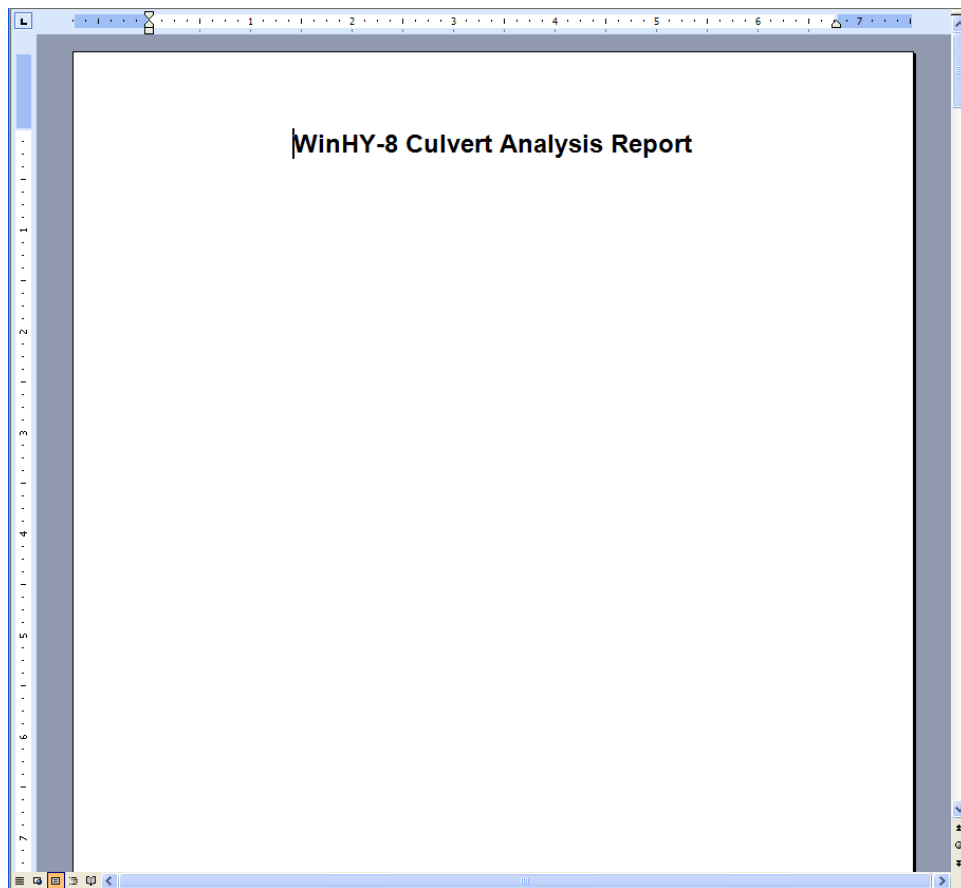


24. Select OK to export the data in the *Included fields* window to a report file. Additional data could be exported by selecting some or all items in the *Available fields* window and using the right arrow (>) to copy the fields from the available fields to the included fields window.
25. After selecting OK, a rich text (RTF) file is exported and opened in Microsoft Word or whatever application is assigned to open RTF files (possibly WordPad if you do not have Microsoft Word installed). The report could have been exported in PDF format by selecting PDF for the *File Format* in the *Report Generator* window.

Optional: Editing a HY-8 Report

The following steps will describe how to edit a RTF formatted HY-8 report in Word to condense the number of pages and make the document more readable (see discussion on Limitations, above). User experienced with other common word processing programs would apply analogous protocols.

ED-1 If you have Microsoft Word, you should see the following view after exporting the report:



ED-2. Scroll down to the following page. You should see the following table:

Table 1 - Summary of Culvert Flows at Crossing: Crossing 1

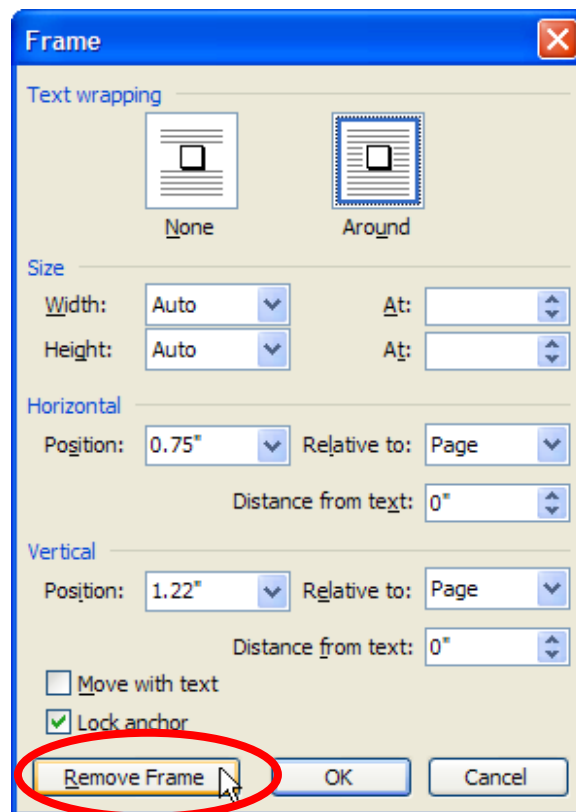
Headwater Elevation (ft)	Total Discharge (cfs)	Example 6 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
90.00	0.00	0.00	0.00	1
92.06	50.00	50.00	0.00	1
93.20	100.00	100.00	0.00	1
94.18	150.00	150.00	0.00	1
95.12	200.00	200.00	0.00	1
96.09	250.00	250.00	0.00	1
97.14	300.00	300.00	0.00	1
98.31	350.00	350.00	0.00	1
99.63	400.00	400.00	0.00	1
101.11	450.00	450.00	0.00	1
102.76	500.00	500.00	0.00	1

ED-3. Click within the table so the border appears around the table. Then right-click on the border of the table and select the *Format Frame* option as shown below:

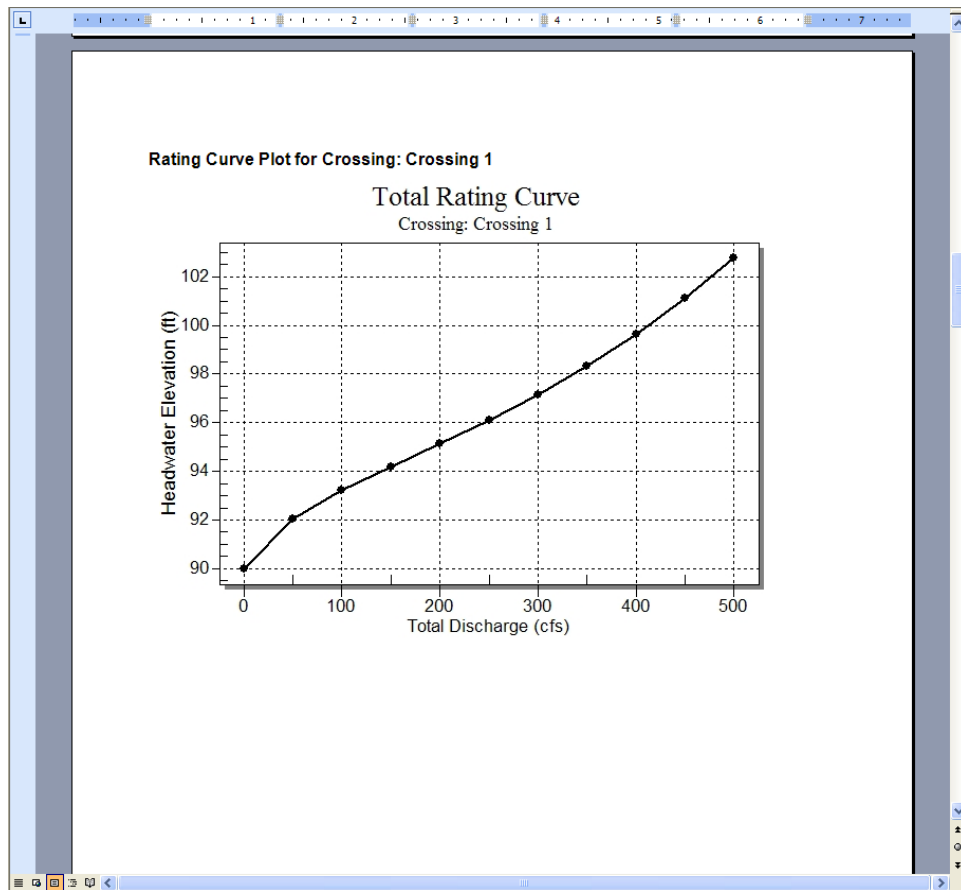
Table 1 - Summary of Culvert Flows at Crossing: Crossing 1

Headwater (ft)	Total Discharge (cfs)	Example 6 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
90.00	0.00	0.00	0.00	1
92.06	50.00	50.00	0.00	1
93.20	100.00	100.00	0.00	1
94.18	150.00	150.00	0.00	1
95.12	200.00	200.00	0.00	1
96.09	250.00	250.00	0.00	1
97.14	300.00	300.00	0.00	1
98.31	350.00	350.00	0.00	1
99.63	400.00	400.00	0.00	1
101.11	450.00	450.00	0.00	1
102.76	500.00	500.00	0.00	1

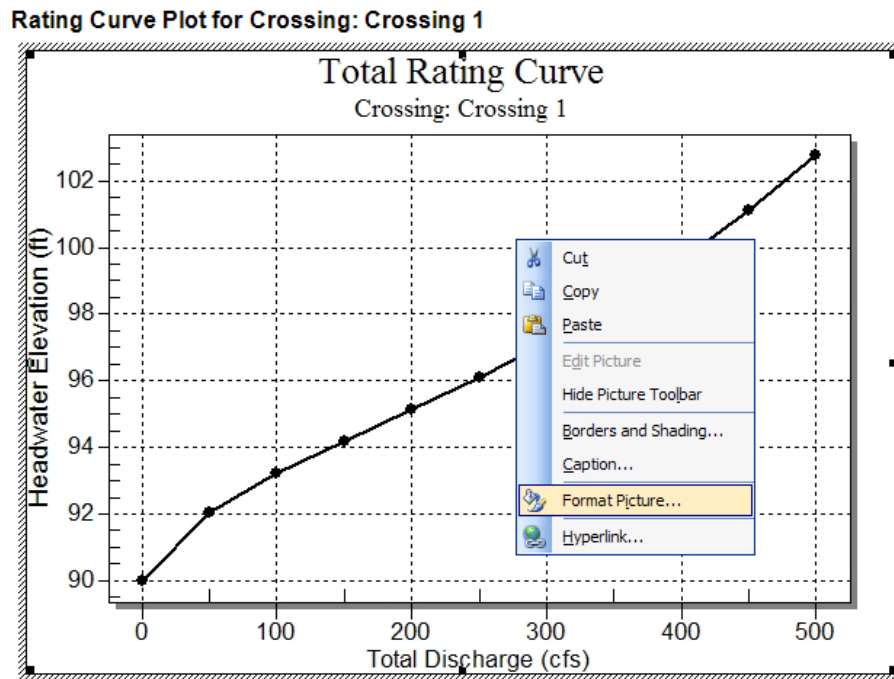
ED-4. In the *Frame* window, select the *Remove Frame* button:



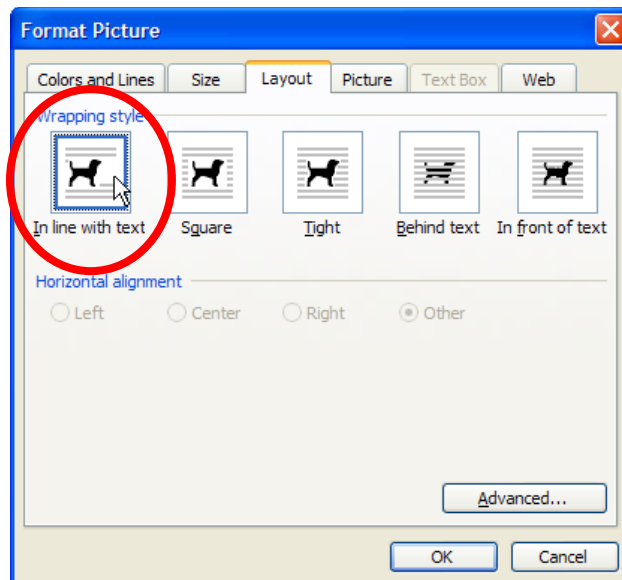
ED-5. Scroll down to the next page. You should see the following graph:



ED-6. Right-click on this graph and select the *Format Picture* option:



ED-7. In the *Format Picture* window, select the *Layout* tab, select the *In line with text* option, and select OK.




- ED-8. Continue editing all your tables and graphs as described in the steps above by locking the anchor on all the tables and setting the graphs so they are all in line with the text.

- ED-9. Select the *View / Normal* menu item. Finish formatting your report document by removing all the unwanted page breaks and adding any additional information you wish to add to the report. After you are done editing, you can select the *View / Print Layout* menu item to see what the report will look like when it is printed.

This concludes the Quick Start tutorial. Additional information may be found within the on-line Help associated with the HY-8 program.

Getting Help

Beyond this and the HDS-5 document, the majority of the HY-8 documentation is self contained within the program. The functional use of the program is documented in the hyper-linked help file available from the Help menu or by selecting help buttons or icons () from the graphical user interface. While the help file is organized to provide context-sensitive help, it can be printed out and organized into a hard copy manual.

Additionally, the National Highway Institute provides courses on application of the HY-8 software (135081 – Introduction to Hydraulic Highway Software” and other courses).

While FHWA does not offer any user support (as described in the Terms and Conditions for downloading and using the program), comments and bug reports may be sent to:

CommentsOnHY8Version7.0@fhwa.dot.gov